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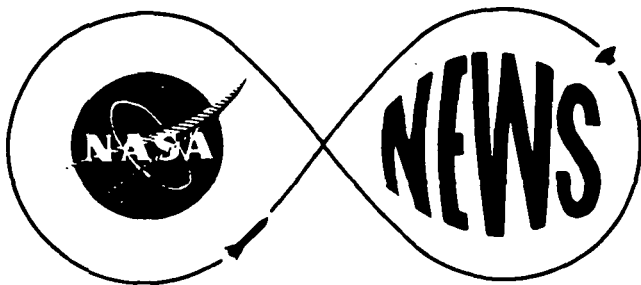
GAMMA RAY SATELLITE TO BE LAUNCHED FROM AFRICA

A significant step in space astronomy will be taken when NASA's Small Astronomy Satellite B (SAS-B) is launched early next month from the Italian-operated San Marco Equatorial Range in the Indian Ocean off the coast of the Republic of Kenya.

SAS-B is the first spacecraft since the small Explorer 11 in 1961 to be devoted exclusively to the study of gamma rays. It is the second in the SAS series developed by NASA's Goddard Space Flight Center, Greenbelt, Md., and will be named Explorer 48 after orbit is achieved.

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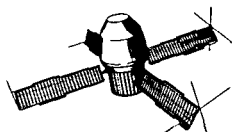
October 13, 1972



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PROJECT: SAS-B



contents

GENERAL RELEASE	1-7
SAS-B SPACECRAFT	8-9
Attitude Stabilization & Control System .	8
Communications Systems	9
THE SPARK CHAMBER GAMMA RAY TELESCOPE. . .	9-10
GAMMA RAY ASTRONOMY.	11-12
UHURU (EXPLORER 42) RESULTS.	13
THE SAN MARCO LAUNCH FACILITY.	14-15
THE SCOUT ROCKET	16
SEQUENCE OF LAUNCH EVENTS.	17
SAS-B PROJECT OFFICIALS.	18-20
SAS-B FACT SHEET	21-22

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The launch, on a Scout rocket into a circular orbit 555 kilometers (345 statute miles) above Earth's equator, is planned for no earlier than the morning of November 2 - local time- near midnight November 1 in the United States.

The 186-kilogram (410-pound) satellite carries one experiment, housed in a large, dome-shaped container mounted on top of a standard SAS control section. The experiment consists of a 32-level digitized spark chamber gamma-ray telescope, designed and built at Goddard. Rare celestial gamma rays will be detected with a determination of their intensity, energy, and direction of arrival. The sensitivity will be about ten times greater than any other gamma ray detector previously orbited.

SAS-B will begin its scientific exploration with an all-sky survey. Following this survey the telescope will be used for a detailed study of discrete gamma ray sources.

Gamma ray astronomy is a comparatively new field and was given high priority in a report entitled "Priorities for Space Research, 1971-1980," published last year by the Space Science Board of the National Research Council.

Gamma rays do penetrate the Earth's atmosphere to balloon altitude (about 36,000 meters: 120,000 feet), but cosmic rays induce a high secondary gamma ray background in the atmosphere; therefore, gamma rays are best observed by satellite-borne instruments. Identification of these gamma-rays requires highly sophisticated instruments such as the digitized spark chamber telescope -- a device originally developed for high-energy physics.

Scientists are particularly eager to know more about celestial gamma radiation in order to obtain an understanding of some of the major energy transfer mechanisms occurring in the universe. Fundamental questions concerning stars, interstellar matter, galactic magnetic fields, and cosmic rays and their interactions may be answered if gamma ray sources and propagation can be understood.

Gamma rays should, for example, provide information on supernovae--exploding stars whose mass is comparable to that of our own Sun. Gamma ray astronomy will also furnish data on the dynamic balance of our galactic disc by which the expansive pressures of the cosmic rays, magnetic fields, and particle motion are balanced by the gravitational attraction of the matter in the galactic disc.

The SAS-B launch will be conducted by personnel of the Aerospace Research Center of the University of Rome (Centro Ricerche Aerospaziali (CRA) dell' Universita Degli Studi di Roma). It is the fifth launch from the San Marco Equatorial Range and SAS-B is the third U.S. satellite to be launched by Italy under an agreement signed April 30, 1969.

The first U.S. spacecraft launched from San Marco, or from any foreign range, was the highly successful X-ray satellite, Explorer 42 (SAS-A), launched December 12, 1970. It was named Uhuru ("Freedom" in Swahili) in honor of Kenya's Independence Day. The second was Explorer 45 (Small Scientific Satellite-A), designed to study energetic particles and fields, launched November 15, 1971. Both spacecraft continue to provide excellent scientific data.

The other two satellites launched from San Marco were part of NASA/CRA cooperative programs, using Italian-built atmospheric study satellites. Named San Marco 2 and San Marco 3, they were launched in April 1967 and April 1971, respectively.

The San Marco facility is ideal for placing satellites into equatorial orbits such as the one needed for SAS-B. Equatorial orbits could be achieved from other launch sites, such as Cape Kennedy, Fla., but would require larger and more costly booster rockets, and difficult flight trajectories.

An equatorial orbit is desirable for SAS-B because at a low inclination the satellite will avoid passing through the magnetic field anomaly in the South Atlantic Ocean. The energetic electrons and protons in the anomaly would degrade the data from the spark chamber.

SAS-B is unique from an engineering standpoint in that the standard satellite subsystems needed to support the experiment are self-contained in a "universal bus" control section on which the spark chamber telescope is mounted. The control section is readily adaptable to a variety of experiment packages. The control section, built by the Applied Physics Laboratory of the Johns Hopkins University, Silver Spring, Md., is 55 centimeters (22 inches) in diameter, and 50 centimeters (20 inches) long.

The Project Manager of the SAS series is the first woman to hold such a post in the U. S. space program, Mrs. Marjorie R. Townsend of the Goddard Space Flight Center. She is responsible for all aspects of the SAS project -- design, fabrication, testing and launch.

Mrs. Townsend received an engineering degree from the George Washington University in 1951. She was recognized for exceptional managerial ability with the NASA Exceptional Service Medal in October 1971. She recently received the award of Knight of the Italian Republic Order in Rome.

Data from SAS-B will be acquired primarily by the NASA Spaceflight Tracking Data Network (STDN) station at Quito, Ecuador. Other data acquisition sites include U.S. stations at Ascension Island, the Seychelles Islands, and French-operated sites at Kourou, French Guiana, and Brazzaville, Republic of the Congo, as well as at San Marco. The data will be sent to the Goddard Space Flight Center for analysis.

After evaluation and analysis by the principal investigator and his colleagues, the scientific data will be deposited in the NASA Space Science Data Center, Greenbelt, Md., for use by the world scientific community.

The SAS-B program is part of the Explorer series of scientific satellites directed by NASA's Office of Space Science. The NASA Goddard Space Flight Center is responsible for SAS-B Project Management and development of the gamma ray experiment. The Applied Physics Laboratory is prime contractor for the SAS-B control section and integration of the spark chamber experiment.

NASA's Langley Research Center, Hampton, Va., manages the Scout launch vehicle program, and the prime contractor for the Scout is LTV Aerospace Corp., Dallas, Texas.

Approximate costs of the SAS-B mission are \$9 million for the spacecraft, including the experiment, \$1.45 million for the Scout launch vehicle, and \$600 thousand to Italy as reimbursement for launch costs.

(End of General Release - Background Information follows)

THE SAS-B SPACECRAFT

The unique SAS-B satellite control section is a 55-centimeter (22-inch) cylinder made of aluminum. It houses the command system, telemetry system, stabilization system, tape recorder, and batteries. It is designed to be adaptable to carry a wide variety of experiment packages. The spark chamber gamma ray telescope and related equipment, housed in a dome-shaped structure, is mounted on top of the control section. Overall length of the fully assembled satellite is 129 centimeters (51 inches).

Four solar panels are attached to the control section. During launch they are folded against the fourth stage of the Scout rocket. Once in orbit, the solar panels are extended perpendicular to the control section. The tip-to-tip length of the panels is 396 centimeters (156 inches). Mounted on the tip of each panel is either a command or a telemetry antenna.

Solar cells mounted on the panels supply an average of 27 watts power to recharge the satellite's nickel-cadmium battery package.

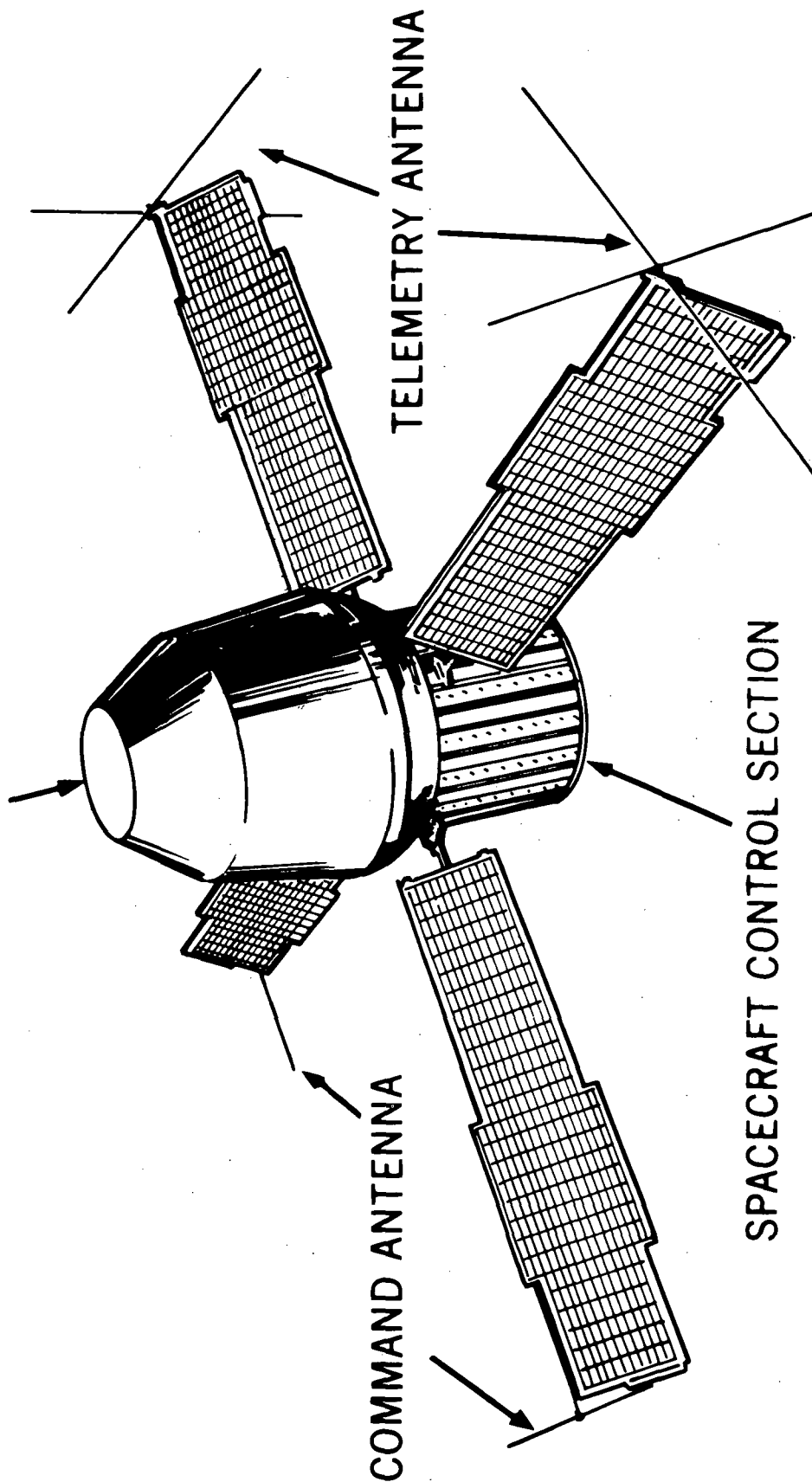
Attitude Stabilization and Control System

The orbital location and attitude of SAS-B must be known at all times. This information is necessary to determine the direction of arrival of the gamma rays and, thus, the position of the source from which they came.

While the orbital location of the spacecraft is determined by ground tracking stations, the satellite's attitude is controlled and monitored by an onboard system. Similar to that of Uhuru, (SAS-A), it consists of separate systems for spin-axis orientation and spin-rate control, a stabilizing rotor to provide adequate angular momentum for good gyro-stabilization, a nutation damper, a chargeable trim magnet system, and a star sensors. In conjunction with a ground computer which defines the turn-on time of on-board electromagnets, this system uses Earth's magnetic field for torquing, thus it requires no control gas system.

This attitude stabilization and control system can control the attitude of the satellite in different orientations within three degrees and determine orientation to an accuracy of one-fourth of a degree.

SPARK CHAMBER EXPERIMENT



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COMMAND ANTENNA

TELEMETRY ANTENNA

SPACECRAFT CONTROL SECTION

SMALL ASTRONOMY SATELLITE - B

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Communications System

Communication between the ground and the spacecraft is accomplished by using the redundant command receivers and decoding any of 60 commands on board the satellite. Commands originating at the SAS Control Center at the Goddard Space Flight Center are sent primarily to the NASA tracking station at Quito, Ecuador, for transmission to the spacecraft.

Data obtained by the satellite will be stored on a tape recorder. As the spacecraft passes over the ground station, the tape recorder speed is increased by a factor of 20, permitting data from a full 96 minute orbit to be transmitted to the ground in approximately 5 minutes by a VHF transmitter.

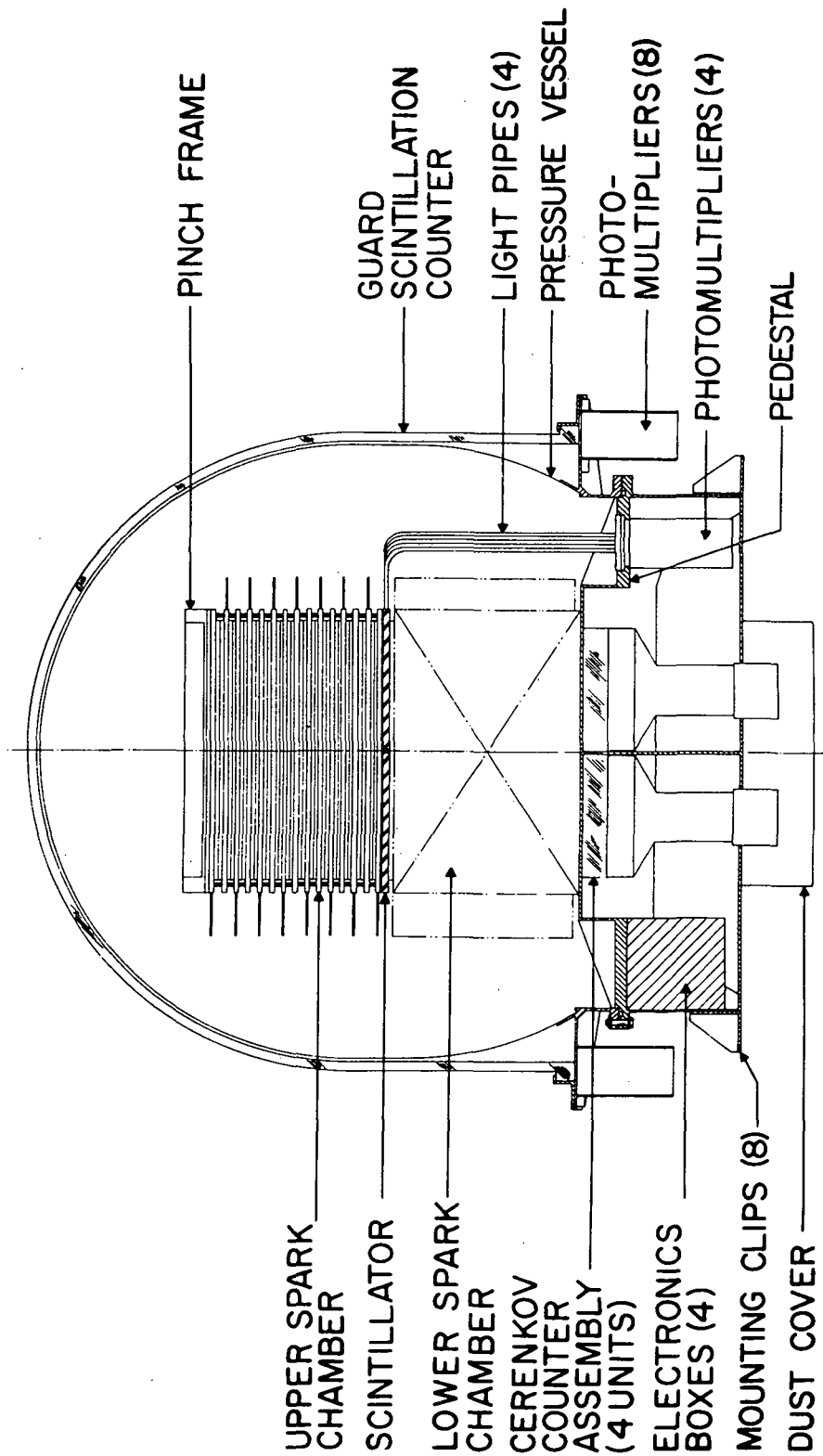
The data are transmitted in digital form and include information on the operation and condition of the spacecraft and experiment as well as experiment data. In addition to being stored on board, data can be transmitted at 1000 bits per second in real time by the same transmitter.

THE SPARK CHAMBER GAMMA RAY TELESCOPE

The SAS-B experiment represents the first satellite version of a digitized spark chamber gamma ray telescope. It is the out-growth of a series of spark chamber devices developed at the Goddard Space Flight Center, under the direction of Dr. Carl Fichtel. The first such devices were carried aloft on high altitude balloons.

The heart of this experiment is a thirty-two-deck digitized spark chamber which allows a three-dimensional "electronic picture" to be made of the trajectory of the electron pair created by an incoming gamma ray in one of the thin plates between the spark chamber decks. The large detector dome over the spark chamber discriminates against charged particles; other counters determine when the spark chamber should be pulsed and data read out.

The experiment will be pointed along the spacecraft axis, and the information on the arrival direction and energy of each gamma ray is obtained directly from an analysis of the spark chamber track.



SAS-B Gamma-Ray Experiment

The telescope has a sensitivity far greater than any satellite gamma-ray experiment flown thus far. It will be able to determine the arrival directions of gamma rays to about one degree. The energy spectrum from about 25 to 200 MeV and the total flux above that energy will also be measured. Thus, it should provide the fundamental data needed to determine the nature of the gamma radiation that comes from the galactic plane.

A sky survey will be performed to look for gamma-ray stars with a sensitivity about 10 times better than possible with other current experiments.

The specific scientific objectives of the SAS-B experiment are:

- * To measure the dependence on direction of the galactic and extra-galactic diffuse gamma radiation with an accuracy of about one degree for gamma rays above 100 million electron volts. (Visible star light is in the range of about two electron volts.)
- * To measure the energy spectrum of this gamma radiation as a function of direction in the range from 25 to 200 million electron volts and the integral intensity above 200 million electron volts.
- * To determine whether discrete sources of gamma radiation exist both within and external to our galaxy at a flux level detectable with the experiment on SAS-B and to measure the position, intensity, and energy spectra of any discovered sources.
- * To look for short burst of gamma rays from supernovae.
- * To look for pulsed gamma radiation from pulsars.

GAMMA RAY ASTRONOMY

In a report entitled "Priorities for Space Research, 1971-1980," prepared last year by the Space Science Board under auspices of the National Academy of Sciences, the Astronomy Working Group stated:

High-energy photon astronomy has developed during the past decade into one of the most fruitful areas of modern astronomy. Experiments conducted above the obscuring atmosphere have extended observations beyond the ultraviolet by more than six decades of the spectrum and have resulted in the discovery of surprising and unexpected sources of celestial X and gamma rays. These discoveries have already had major impact on our ideas regarding the origin and early history of the universe, stellar and galactic evolution, the properties of the interstellar medium, and the origins of cosmic rays. The promise of continued important advances and the challenge of the observational problems have attracted many capable experimentalists to the field and have inspired the development of a battery of new techniques for the detection and analysis of radiation in space. Thus, the necessary foundation exists for a program that will exploit these recent scientific breakthroughs during the coming decade.....Meanwhile, a sustained program of smaller exploratory investigations will continue to stimulate new technical developments and assure a continuing yield of new discovery.

Gamma ray astronomy, as a relatively young discipline, plays an important role in what may be called "the new astronomy." Scientific literature on the subject is sparse.

The primary mission of SAS-B is to make the first detailed sky map of gamma ray emissions. This will be the first complete map of the celestial sphere to show in detail the general origins of this energy.

Gamma rays are a form of electromagnetic radiation similar to the photon particles in visible light. However, they are vastly more powerful, with energies ranging upwards from 200,000 times the energy of visible light photons.

These very strong sources of radiation cannot be detected on Earth's surface because they are absorbed in the atmosphere. Thus, the satellite, capable of long-term observations, is the best means of conducting gamma ray studies. However, early studies of gamma rays, for short time periods, have been conducting using balloons and sounding rockets. To date the bulk of our gamma ray knowledge comes from balloon flights and from experiments on OSO-3 and OSO-7.

However, even above the atmosphere observing gamma rays is difficult. This is because their intensity is low compared with the intensity of high background cosmic rays. Also, gamma rays interact with matter in a far different way than, for example, visible light. Visible light is absorbed by having its energy transferred to an electron already existing in matter. Gamma rays, on the other hand, are absorbed in matter by a transformation into an electron-positron pair, a complicated process. It is through the detection of the electron-positron pair that gamma rays can be observed and their characteristics determined.

Learning more about gamma radiation, its origin, and its mechanics is of considerable scientific interest because it provides physicists with a potential means of detecting many of the major energy transfers occurring in the cosmos.

Understanding gamma rays can thus help answer fundamental questions about stars, interstellar matter, galactic magnetic fields, cosmic rays, and their exceedingly complex interactions.

Other key objectives in gamma ray astronomy are:

- * To measure the gamma ray intensity in various regions of the sky to help determine whether they exist in intergalactic space as well as our galaxy.

- * To provide a better understanding of the dynamics of supernovae.

- * To determine the validity of one version of the steady-state theory of the universe which states matter is being formed by the continuous spontaneous creation of particles and antiparticles.

UHURU (EXPLORER 42) RESULTS

X-ray astronomy results from Uhuru (Explorer 42), the first of the SAS series, are considered by scientists to be highly significant to high-energy astronomy. (A definitive summary of findings was published in Science journal of January 28, 1972.)

Thus far, a catalogue of 125 X-ray sources has been prepared from Uhuru data. In addition, the satellite's important findings include:

- * Discovery of rapidly varying X-ray sources whose properties differ in many respects from those of the more common radio pulsars;
- * The detection of X-ray emission from Seyfert galaxies;
- * Discovery of X-ray emissions from peculiar sources such as quasars;
- * Discovery of binary star systems identified solely on X-ray data;
- * Possible data to support the "Black Hole" theory.

NASA's first two satellites devoted to high-energy astrophysics, Uhuru and SAS-B, as well as future SAS spacecraft designed to study ultra-violet and infrared sources and to make more detailed X-ray studies, will provide guides for large-scale studies by the High Energy Astronomical Observatory (HEAO), being planned by NASA for launch in the late 1970s.

Summarizing results from Uhuru, thus far, Dr. Carl Fichtel, SAS Project Scientist, reports: "Uhuru represents a giant step forward in astronomy by providing the first complete and sensitive picture of the sky in X-rays. These results from the satellite confirm the expectation that not only significant, but some unexpected phenomena would be discovered, relating directly to the fundamental high energy processes which govern the evolution of stars and galaxies."

THE SAN MARCO LAUNCH FACILITY

The San Marco Equatorial Range is owned and operated by the Italian government. It is composed of two off-shore platforms stationed in Formosa Bay about three miles off the coast of Kenya, 2.9 degrees south of the Equator.

The launch platform, San Marco, is located approximately 500 meters (550 yards) from the Santa Rita platform, which houses the control and operations center and supporting range equipment.

The launch platform, a surplus U.S. Army ocean dock, has 20 steel legs embedded in the sandy seabed at latitude 2 degrees 56 minutes 18 seconds South, longitude 40 degrees 12 minutes 45 seconds East -- ideal for equatorial space launchings.

A 36.5 meter (120-foot) shelter, which houses the Scout vehicle during vehicle assembly and checkout prior to launch, provides an air-conditioned environment for the vehicle while on the launcher. A large pit on the launch platform, open to the sea, absorbs the exhaust of the Scout first-stage motor. Spacecraft checkout facilities are also available on the San Marco platform.

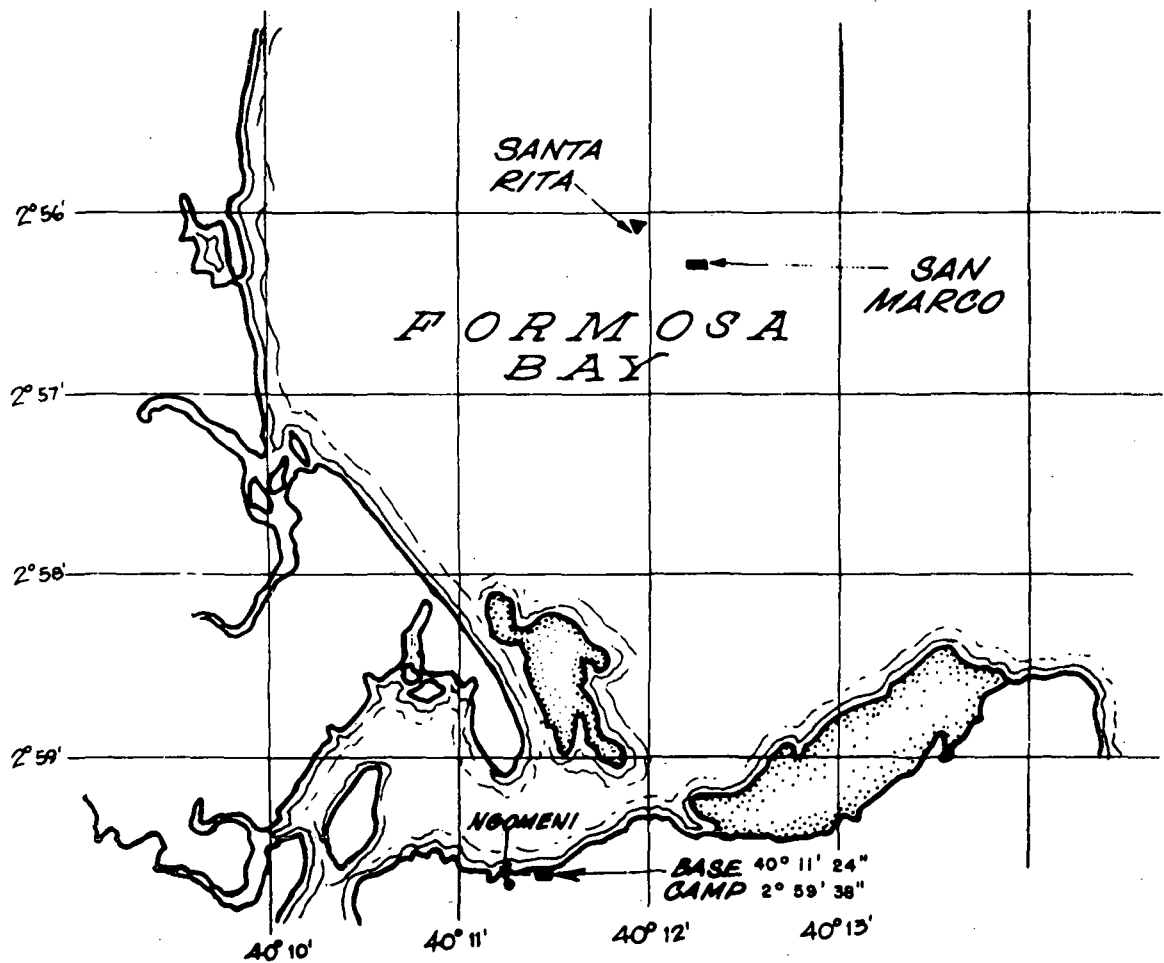
The Santa Rita platform, a LeTourneau oil drilling platform modified by the Italian firm Nuova Pignone, houses the control center, control room and the instrumentation required to launch and track the Scout.

Twenty-three undersea cables link the San Marco launch complex with its sister platform. More than 3,000 connections of various kinds link the two platforms. Independent generators at the two locations provide electricity at two voltages to meet the requirements of the scientific equipment and the housing and other facilities.

Logistical support for platform operations is provided by a base camp facility located on the shore of Formosa Bay at Ngomeni Point. Here, communications, supply, mess, and housing facilities are available to range users.

The overall operation is made possible through the cooperation of Republic of Kenya technical and scientific organizations such as EAPT (East African Post and Telecommunications), EARH (East African Railroad and Harbours), East African Meteorological Service, and others.

DETAILED MAP OF SAN MARCO RANGE FACILITIES



San Marco Platform - Scout Launch Facility
Santa Rita Platform - Range and Communications Control

This cooperative effort is covered by an agreement between the CRA and the University of Nairobi and by a memorandum of understanding between the Kenyan Government and the Italian Government.

Under the agreement the Kenyan Government also leases the land, near the village of Ngomeni, for the San Marco Range Base Camp.

THE SCOUT ROCKET

Scout is NASA's only solid propellant launch rocket capable of placing payloads in orbit. The first developmental Scout was launched July 1, 1960. The SAS-B mission is expected to be the 81st Scout launch. Since the Scout was recertified in 1963, the launch vehicle has attained a 95 percent success record.

Scout is a four-stage solid propellant rocket system. Scout S-170 and the spacecraft will be set on an initial launch azimuth of 87 degrees to obtain a 555 kilometer (342 statute mile) circular orbit, with a 1.8-degree inclination. The spacecraft will orbit the earth every 96 minutes.

The four Scout motors -- Algol III, Castor II, Antares II, and Altair III -- are interlocked with sections that contain guidance, control, ignition, and instrumentation systems, separation mechanics, and the spin motors needed to stabilize the fourth stage. Control is achieved by aerodynamic surfaces, jet vanes, and hydrogen peroxide jets.

The launch vehicle is approximately 22 meters (73 feet) long and weighs about 21,485 kilograms (47,365 pounds) at lift-off. The four stages develop a total impulse of 46,301,446 newton-seconds (10,417,825 pound-seconds).

The Scout program is managed by NASA's Langley Research Center, Hampton, Va. The launch vehicle is built by LTV Aerospace Corp., Dallas, Texas.

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SAS-B LAUNCH SEQUENCE OF EVENTS

<u>Event</u>	<u>Time (Seconds)</u>
Liftoff	0.00
First stage termination	83.44
Second stage ignition	83.44
Second stage burnout	122.04
Third stage ignition	145.85
Third stage burnout	182.54
Spin-up	590.00
Third stage separation	591.5
Fourth stage ignition	596.35
Fourth stage burnout & orbital injection	627.97
Spacecraft separation	922.15 (plus or minus 30)

Separation and Despin Operations

SAS-B is attached to the Scout fourth stage by a concal adapter. This adapter contains redundant devices to time the occurrence of despin, solar panel deployment, and spacecraft separation from the fourth stage.

Between three and six minutes after fourth stage ignition either or both timers will fire a pyrotechnic cable cutter. Cutting the cable releases the despin weights, and unwinding of the despin cables allows the solar blades to deploy. This sequence of events will reduce the spin rate from about 137 rpm to about five rpm.

About three minutes after the release of the despin weights, the second step of the timers will fire the separation clamp bolt cutters, thus releasing the spacecraft from the fourth stage.

Separation will be accomplished by three helical springs that generate a relative velocity of almost one meter (3.3 feet) per second between the spacecraft and the fourth stage. Now in orbit, Explorer 48 will be ready to begin its scientific mission.

SAS-B PROJECT OFFICIALS

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Dr. Albert G. Opp	Program Scientist
Leon Dondey	Program Engineer
Joseph B. Mahon	Director, Launch Vehicles and Propulsion Programs
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Dr. Carl Fichtel	SAS Project Scientist and Principal Investigator
John M. Bosworth	SAS Spacecraft Manager
Anthony J. Caporale	SAS-B Experiment Manager

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Thomas A. Page	SAS Quality Assurance Manager
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C. W. Winters	Head, Launch Operations
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R. L. Duncan	Operations Engineer

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Robert C. Pike	SAS-B Coordinator
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LTV AEROSPACE CORPORATION

Ken A. Gustafson	Program Manager, Scout
Richard D. Urash	Chief Project Engineer
R.D. Fielder	San Marco Field Engineer
William W. Campbell	San Marco Project Engineer

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SAS-B FACT SHEET

Launch: From San Marco Equatorial Range, located in Formosa Bay, Indian Ocean, off coast of Republic of Kenya.

Launch Rocket: Four stage, solid-fuel Scout rocket built by Ling-Temco-Vought Aerospace Corp., Dallas, Texas.

Planned Orbit: Circular, equatorial orbit 555 kilometers (345 statute miles) inclined less than 2 degrees with a period of 96 minutes.

Operating Lifetime: One Year.

Satellite Weight: 186 kilograms (410 pounds) with gamma ray spark chamber experiment accounting for slightly over one-half of overall weight.

Main Structures: Main body consists of dome-shaped experiment section and control section, 55 centimeters (22 inches) in diameter and about 129 centimeters (51 inches) long.

Appendages: Four paddle-shaped solar panels 145 centimeters (58 inches) long and 26 centimeters (10.5 inches) wide. At tips of paddles are command and telemetry antennas.

Power System: Solar cells supply an average of 27 watts power to recharge nickel-cadmium batteries.

Communications and Data-Handling System:

Telemetry: Pulse-Code Modulated/Phase Modulated (PCM/PM) VHF transmitter at 1000 bit per second data rate with tape recorder storage onboard.

Commands:

Spacecraft handles 36 commands and the experiment decodes an additional 24 commands.

Tracking and Data Acquisition:

Primary station is the Spaceflight Tracking Data Network (STDN) station at Quito, Ecuador, augmented by other equatorial stations as required.

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